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PROVINCE OF SASKATCHEWAN
DEPARTMENT OF PUBLIC HEALTH
DIVISION OF SANITATION

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Sewage Disposal

for

Rural Homes

in Saskatchewan

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NOTE

This bulletin has reference only to sewage disposal for rural homes.

Authorities desiring information on the disposal of sewage for schools, convents, hospitals and other public buildings should make special application to the Division of Sanitation of the Department of Public Health, Regina.

Sewage Disposal for Rural Homes in Saskatchewan

INTRODUCTORY

Sewage is the waste or used water from a household or community and consists of a relatively large volume of water and a small amount of solids.

Under the provisions of the Provincial Plumbing and Drainage Regulations it is prohibited to discharge sewage into the subsoil within 35 feet of any residence, or onto the ground surface within 100 feet of any residence. Likewise, a septic tank and approved disposal system must be constructed for every building which has plumbing fixtures installed and not connected to a municipal or common sewerage system.

If all solids contained in sewage, including those in solution, are removed then the remaining liquid is no longer obnoxious, although it may contain harmful bacteria. Such complete treatment is entirely impractical and the best we can hope for is the removal of at least a portion of the solids held in suspension. This can be accomplished by allowing the sewage to flow slowly through a settling tank so that the solids will settle to the bottom.

SEPTIC TANKS

A septic tank is nothing more than a settling or sedimentation tank which is made large enough to allow for considerable storage of the solids which settle to the bottom. This provision permits a partial reduction of the settled solids by bacteria. Actually no purification of the sewage takes place and the liquid portion discharged from the tank is usually just as obnoxious, offensive and dangerous as the raw sewage entering the tank.

What then is the purpose or value of a septic tank? Just this: It accomplishes the removal of the larger solid particles and permits final disposal of the liquid with a minimum of nuisance. It also reduces the amount of solids which must be eventually removed and hauled away to a suitable point of disposal. Likewise, in those installations where final disposal of the liquid is by sub-soil absorption, the removal of the solids prevents rapid clogging of the soil.

In a properly functioning septic tank a scum usually forms on the surface of the liquid. This is caused by grease, and rising bubbles of gas carrying the lighter suspended solids to the surface. The scum does no harm but it should be broken up when it reaches a thickness of about one foot.

IT IS IMPORTANT THAT THE ACCUMULATED SOLIDS IN THE SEPTIC TANK BE REMOVED PERIODICALLY, otherwise the space occupied will be so great that solids will not have an opportunity to settle out of the sewage. When that happens, the solids will simply pass out with the liquid and the entire purpose of the settling tank will be defeated.

The septic tank should be examined at least yearly and if the depth of solids, including scum layer, totals about one and one-half feet, some of the solids should be removed. In no case should the total depth of solids be permitted to exceed two feet. It is not necessary, nor desirable to remove all the solids at each cleaning.

It is not necessary, and a waste of money to add yeast cakes or any other "starter" to the contents of septic tanks. The bacteria which are responsible for the reduction of solid matter are abundantly contained in all human wastes. The temperature, however, is important. The warmer the contents of the tank, the more thorough will be the bacterial action. For that reason a new system should not be started in the winter time if it can be avoided.

As the solids decompose the temperature gradually rises with increasing efficiency of the digestion or reduction process. Additional heat may be supplied for winter starting (or operation) by the installation of a vertically mounted immersion heater where electrical energy is available and not too expensive. The 1,000 watt size used for stock water-tank heating is suitable.

ALL HOUSEHOLD WASTES INCLUDING LAUNDRY WASTES SHOULD BE DISCHARGED TO A SEPTIC TANK, with the possible exception of wash water from a zeolite water softener. Ordinarily, the same is true for wastes from other places such as hospitals and schools. However, roof or drainage waters should be by-passed, as they require no treatment, and where quantities of grease are discharged to the sewer it may be desirable to provide a grease trap ahead of the septic tank. Grease traps must be serviced frequently, usually daily, otherwise they are not effective and serve no useful purpose. A design for a grease trap is shown in Figure 5 as used in connection with a seepage pit.

Location of a Septic Tank

The excavation necessary for a septic tank may be greatly reduced if advantage is taken of any fall which there may be in the ground surface. The waste outlet or building drain from the house should be at the point nearest the site of the tank so that the tank need not be located to suit the waste outlet.

If the tank is built against the basement wall of a building it must be watertight and not less than 9 inches thick. In no case may a basement wall be used as a wall of the tank.

Tanks should be on a site which will permit easy access for inspection and cleaning, and surface drainage should be away from it. The elevation of the tank must be such that there will be sufficient fall in the sewer connection between the building and the tank. (See Figure 3).

House Connections

The house connection or building sewer may be cast iron pipe, vitrified clay tile, concrete or bituminized fibre pipe from a point not less than 3 feet beyond the house or building. The internal diameter must not be less than 4 inches and for tile or concrete pipe a 6 inch diameter is recommended.

The slope of the house sewer, from the building to the septic tank should be not less than about ¼ inch per foot for 4 inch diameter pipe. Cast iron pipe with lead or otherwise tight joints should be used if the pipe is within 50 feet of a well or 10 feet of a drinking water supply line under pressure.

A manhole should be constructed at every change in direction of 45 degrees or more.

The Septic Tank

The minimum liquid capacity of septic tanks serving dwellings should be 400 Imperial gallons in the sedimentation compartment. The inside dimensions (Figure 1) should not be less than 5 feet 6 inches long, 3 feet wide and have a minimum liquid depth of 4 feet. This size tank may be used for all installations for 5 persons or less. Other sizes are shown in Table 1.

All tanks must be designed to allow the sewage to enter at one end, have a slow uniform flow through the tank and discharge the settled sewage at the opposite end, with the least possible disturbance of the tank contents. The tank should have a length of about 2 times the width but not more than 3 times the width. Circular tanks do not meet the above conditions, unless laid horizontally or placed vertically in series with each settling compartment having a minimum liquid capacity of 100 Imperial gallons.

Inlets and outlets must be baffled. This may be accomplished by discharging the sewage through a cast iron tee pipe which should extend 12 to 15 inches below the water line (See Figure 1). The effluent or liquid leaving the tank must be drawn off in a similar manner to prevent the discharge of scum or floating matter. The outlet pipe should be 3 inches below the level of the inlet pipe and should extend 15 to 18 inches below the liquid level. Gases which develop in the tank, escape through the top leg of the inlet tee and through the building sewer and vent stack to the roof of the house or building.

All tanks must be provided with at least one manhole, placed above the inlet. Manholes should be not less than 20 inches square or 24 inches in diameter, and have a tight fitting cover. They may be extended to the ground surface or to a point near the surface.

Septic tanks should be constructed of good concrete or other material not subject to excessive corrosion. Prefabricated metal tanks are acceptable for short term use providing they comply with the requirements for size and design as outlined herein. The metal should be at least 12 gauge.

An earth covering of 2 feet or more is recommended to prevent freezing of contents of septic tanks, and to provide a more uniform temperature. The accumulated solids or sludge must be removed periodically. The tank capacities outlined in Table 1 have a normal sludge storage for about 2 years. They are designed on the basis of a sewage flow of 35 Imperial gallons per person per day.

TABLE 1

SEPTIC TANK SIZES FOR DWELLINGS

Based on a sewage flow of 35 gal/cap/day, with sludge storage of 6 cu. ft. per capita.

Number of Bedrooms	Maximum number of persons served	Width (Inside) Ft.	Ins.	Length (Inside) Ft.	Ins.	Liquid Depth Ft.	Ins.	Total Depth (Minimum) Ft.	Ins
2 or less	5	3	0	5	6	4	0	5	0
3	6	3	0	6	0	4	0	5	0
4	8	3	6	7	0	4	0	5	0
5	10	3	6	7	6	4	6	5	6
6	12	4	0	8	0	4	6	5	6
7	14	4	0	9	0	4	6	5	6
8	16	4	0	10	0	4	6	6	0

The design for other than minimum capacities should be based on a minimum sewage flow of the following:

Dwellings and boarding houses* — 35 Gals. per capita
Small hospitals (up to 15 beds) — 100 Gals. per bed
Day schools — 10 Gals. per pupil
Tourist camps — 20 Gals. per capita

(*Boarding schools includes communal residences)

Care must be exercised in the design of septic tanks for other than dwellings to provide for the wider fluctuations in water use and related sewage flow.

Syphon Chamber and Automatic Syphon

If the ground is suitable for an absorption field, a syphon chamber, equipped with an automatic syphon, should be constructed along with and form a second chamber to the septic tank (see Figure 1). The addition of a syphon chamber and syphon increases the cost of the installation. However, intermittent dosing of sub-surface fields is desirable, particularly in the larger installations. Not only will this permit full use of the absorption bed but it will minimize frost problems.

The syphon or dosing chamber should be of sufficient size to fill all field tile about half full at each discharge. However, the discharges should not occur more than about once every 4 to 6 hours. For small installations about 3 discharges per day is recommended. This is obtained by making the syphon chamber capacity about 1/3 that of the septic tank. The action of the syphon is as follows: The U trap (see Figure 1) is filled with water and as the sewage flows into the syphon chamber, air is entrapped in the bell which covers the long leg of the U.

The sewage is prevented from discharging by the weight of the liquid in the short leg of the syphon. When the surface of the sewage has risen high enough in the syphon chamber, the resulting head on the bell end of the syphon overcomes the pressure of the column in the short leg and part of the sewage in the latter is forced out.

This starts the full flow through the syphon which continues until the sewage in the syphon chamber falls to the under side of the bell when air is again admitted, the pressures are equalized and the flow ceases.

An overflow pipe from the syphon chamber is necessary in case the syphon should fail at any time. This overflow also acts as a vent pipe to provide air for the syphon. Vent openings should be left in the wall which divides the septic tank from the syphon chamber, if this wall is carried up to the roof of the tank. A manhole similar to those specified for the septic tank is required for the syphon chamber, and wrought iron steps may be provided to facilitate inspection.

Discharge of Effluent into the Subsoil

This method of disposal of septic tank effluent is quite common. However, the subsoil throughout a large part of the Province of Saskatchewan is a non-absorbent clay and the general adoption of this method without special design is not practical.

Under certain favorable conditions a system of subsurface filtration may be used in conjunction with a surface outlet. In such cases the field tiles are underdrained by a second system of tiles 2 to 3 feet below and with a bed of sand or gravel between them. The liquid after filtering through the sand or gravel is collected by the under-drains and discharged into a watercourse or to the ground surface at a lower elevation. A limited amount of bacterial action takes place during the passage of the sewage through the sand or gravel filter. Unfortunately this method is incapable of general application in this province owing to the difficulty of obtaining a surface outlet.

Subsurface Absorption

For disposal by subsurface absorption the effluent from a septic tank overflows to the syphon chamber from which it is periodically discharged by the automatic syphon into a series of open jointed field tile laid under the ground surface. The liquid is gradually absorbed by the sub-soil or soaks through to the underlying strata. In shallow systems evaporation is a major factor.

It is obvious that if the ground is not porous, that is, if there are no indications of sand or gravel, or if it is waterlogged, this means of disposal cannot be adopted without special design.

The ideal depth for subsurface disposal is at one and one-half to two feet below the ground surface. At any depth within about three feet from the surface the maximum efficiency of bacterial action and liquid dispersion is obtained. Soil aeration at shallow depths ensures continuous evaporation and absorption of the liquid. However, our extreme winter temperatures for prolonged periods and our comparatively little snow cover permit frost to penetrate to 7 or 8 feet or more. Under these conditions a shallow absorption field may be rendered inoperative before the winter is over. This is particularly true in the case of small installations which are used intermittently or during a part of the day only. Even household septic tanks which are not covered with 2 feet or more of soil or other insulating material have been known to freeze. Furthermore, and especially when the basement of a building is drained, the house sewer and septic tank must be so deep that a shallow system is seldom possible on our flat prairies.

In view of our frost problems the depth of a subsurface field or system should be 6 feet or more. Under those conditions a subsurface system will not function except in porous material as there is no possibility of surface aeration. However, specially designed trenches may be used. Such trenches should be dug to the depth of maximum frost penetration and filled with very coarse gravel or crushed rock to the level at which the pipe is to be laid. The balance of the construction is similar to that shown in the trench detail, Figure 2.

Construction of an Absorption Field

The proper functioning of a subsurface absorption field is dependent on the absorptive quality of the soil and consequently on soil aeration. The absorptive value can be improved by providing a larger effective absorption area. Unless the sub-soil consists of sand or coarser material, placing gravel under the drain tile will increase the absorption factor. The greater the area covered by the gravel the greater amount of liquid will be absorbed and the less time will be required for aeration. This in turn will control the length of field tile required. The gravel is usually placed in trenches having a width depending on the absorption value of the soil. In no case should the width of the trench be less than 18 inches nor should the cover over the pipe be less than 18 inches.

Field tile should be 4 inches diameter and should be laid with joints ¼" to ½" wide. The top half should be covered with asphalt treated paper, gravel or other suitable material to prevent entrance of soil. Gravel should range in size from ½" to 2½" and should be carried to a height not less than 2" above the pipe. Lines of field tile should be separated at least 4 feet. The maximum length of any lateral should not exceed 100 feet, but the total length of tile should not be less than about 150 feet.

Except in porous sub-soil all drainage pipe should be laid in a trench on a bed of gravel or crushed rock. In such cases there should be not less than 9 inches of gravel or crushed rock beneath the drainage pipe.

It is recommended that sub-surface disposal fields be at least 100 feet from any well. The safe distance from wells will depend on local conditions, and in the case of a drilled well properly sealed against surface contamination a minimum distance of 50 feet is permissible.

Unless already known the effective absorption area required may be based on a percolation test. Percolation tests should be made as follows:

Excavate a 1 foot square or 4 to 6 inch diameter round hole to the depth of the proposed disposal trenches. Fill the hole with water to a depth of at least 6 inches and allow the water to seep away. Repeat this procedure until the drop in water level is at a constant rate. When a constant rate has been reached, observe the time in minutes required for the water level to drop 1 inch. The effective absorption area may be then determined from Table 2.

TABLE 2

TRENCH REQUIREMENTS FROM PERCOLATION TEST

Time Required for Water Level to Fall 1 Inch (Minutes)	Loading Per Sq. Ft. of Trench Imp. Gallons	Loading/Lineal Foot for 18 Inch Trench	Length of 18 Inch Trench Required Per Person for 35 Gal. Per Day Flow
1	3.5	5.2	6.7
5	2.1	3.1	11.3
10	1.5	2.2	15.5
20	0.9	1.3	27.0
30	0.7	1.0	35.0
40	0.6	0.8	44.0
50	0.5	0.7	47.0
60	0.4	0.6	58.0

A distribution box as shown in Figure 2 is desirable, so that the flow will be evenly distributed to all tile lines. A baffle is necessary in most distribution boxes so that the flow will not be directed to the nearest outlet. Bricks laid in mortar or a piece of planking set into the concrete floor will serve as a baffle.

Tile lines should be laid on a slope of about 3 inches in 100 feet and the use of a grade board fastened to stakes driven into the ground will assist in laying field tile to the proper grade. Gravel is placed in the trench to the height of the top of the grade board and this will then result in a uniform slope on which to lay the tile. (See Figure 2).

PUMP-OUT TYPE SEPTIC TANKS

In urban centres, except under certain favorable conditions, the only practical and permissible system of septic tank effluent disposal is to haul it away. The pump-out type septic tank is required in such cases. This consists of a standard septic tank plus a second tank or chamber which receives the flow from the septic tank (see Figure 3). The second tank need not be built adjacent to or as one unit with the septic tank, but may be placed at any convenient location. It must be accessible for emptying and should be near a lane or side street. Unless otherwise favorably located, the second or liquid storage tank must be fully watertight. The liquid must be pumped out periodically to a watertight tank and hauled away to some suitable point of disposal. It may not be pumped onto the ground surface in a village, town or city.

In rural districts the liquid may be pumped onto the ground directly from the storage tank providing the point of disposal is as far removed from the house and water supply as practical and in no case nearer than about 200 feet. A greater distance is preferable, especially if the ground water-table is high. A planting of trees or bush with good surface drainage makes a suitable area on which to discharge the effluent. In no case may sewage or septic tank effluent be discharged to gardens for irrigation of garden produce.

No syphon is required in an installation of this kind, but the liquid storage tank should be large enough to hold at least one week's flow of sewage.

Above-Ground Filters

A system of septic tank liquid disposal has been used with considerable success in those areas where the sub-soil is non-absorbent or where the ground water-table is near the surface. It consists of a mound of sand and gravel, covered with earth to which the liquid is discharged by pumping.

About 10 cubic yards of sand and gravel is mounded up as shown in Figure 6 and covered with earth to a depth of about 2 feet. It is important that the earth be loosely placed and not tightly compacted. A covered distribution box is placed in the centre at the top of the gravel portion of the mound and a copper pipe from a pump discharge is connected to it.

The construction of the septic tank is identical to that shown in Figure 1, but a pump suction chamber replaces the syphon chamber. It is preferable to place the pump in the basement of the building served and it should be operated automatically. To do this, electrodes are suspended in a pipe adjoining the suction chamber and connected to a relay and the pump motor. The pump should have a capacity not exceeding about 4 or 5 gallons per minute and usually a ¼ horse-power motor is amply large. The sewage is discharged to the above-ground filter and is dissipated in just the same manner as in a sub-surface filter. A gravel filled trench around the periphery is recommended although it is not absolutely essential.

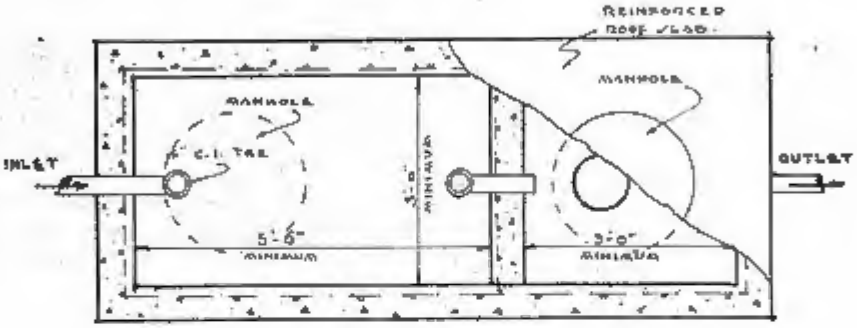
Seepage Pits

On farms where the subsoil is porous a seepage pit as shown in Figure 4 may be used instead of an absorption field. The seepage pit may be located at any suitable point with respect to the septic tank, but like absorption fields, they must be at least 100 feet from any well or source of domestic water supply. The seepage pit should be provided with a manhole or other opening so that any surplus liquid which is not absorbed can be pumped out. Expensive construction is not required but the pit must be adequately cribbed to prevent collapse and must be suitably covered. In impervious soils the pit will serve the purpose of a liquid storage tank.

In urban centres, where the subsoil is impervious a similar pit may be used instead of a watertight liquid storage tank if other conditions are favorable. However, no such installation may be made without approval.

When a complete plumbing system is not contemplated, but only a kitchen sink or basin is to be installed, a seepage pit may be used instead of a septic tank. However, the soil will clog rapidly unless a grease trap as shown in Figure 5 is provided at some point between the house and the seepage pit. A seepage pit will not function as such in an impervious sub-soil and in any case the pit must be so located that there is no danger of polluting water supplies.

FIGURE 1
PLAN & SECTION OF SEPTIC TANK & SYPHON CHAMBER



PLAN

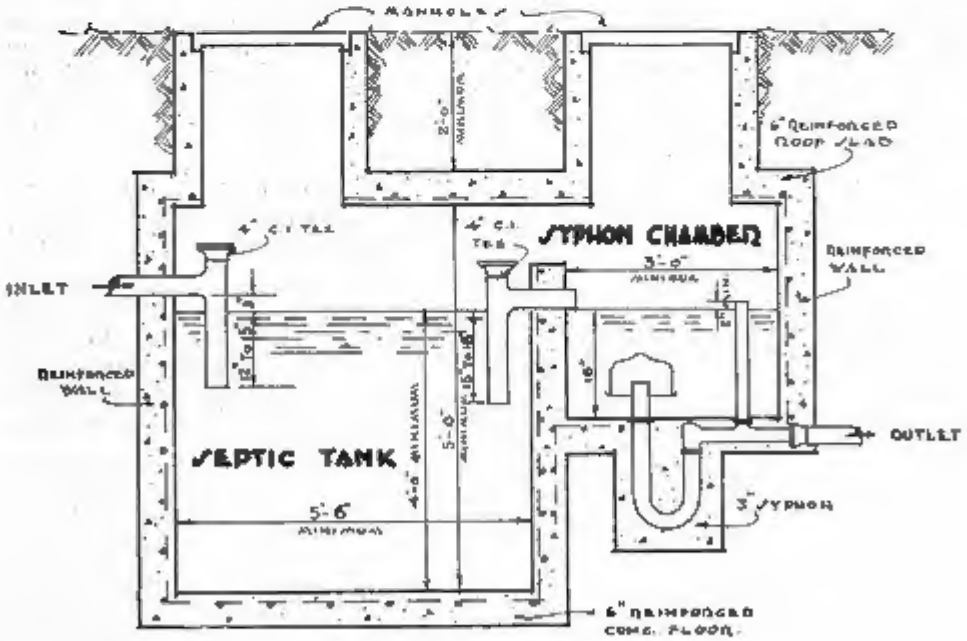
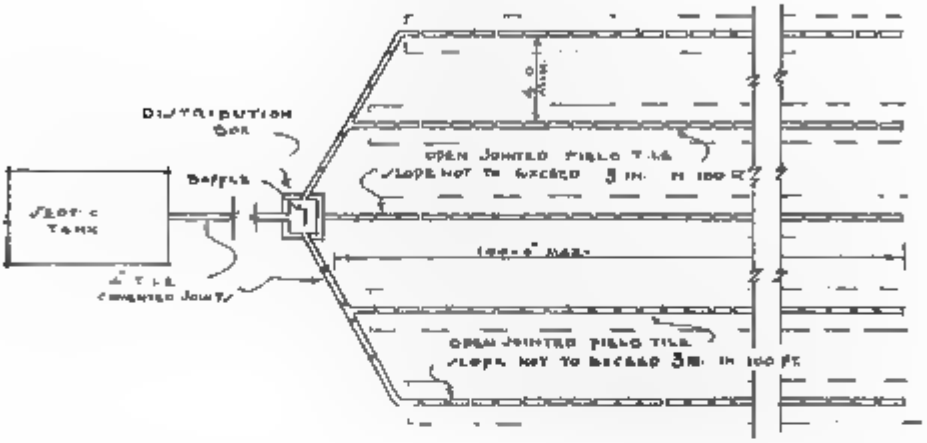
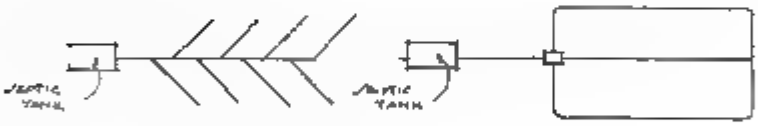


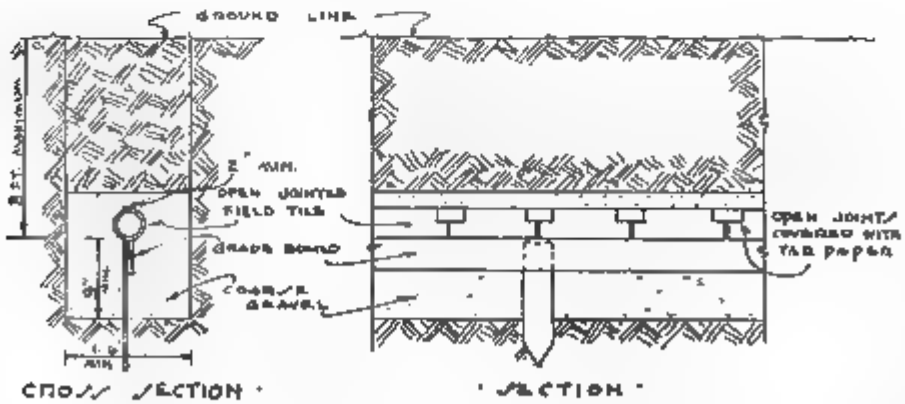
FIGURE 2
DETAILS OF ABSORPTION FIELD AND TRENCH



PLAN



ALTERNATE DESIGNS



CROSS SECTION · SECTION ·

· DETAILS OF TRENCH ·

FIGURE 3
PUMP-OUT TYPE SEPTIC TANK
(SEPTIC TANK COMBINED WITH STORAGE TANK)

· PLAN ·

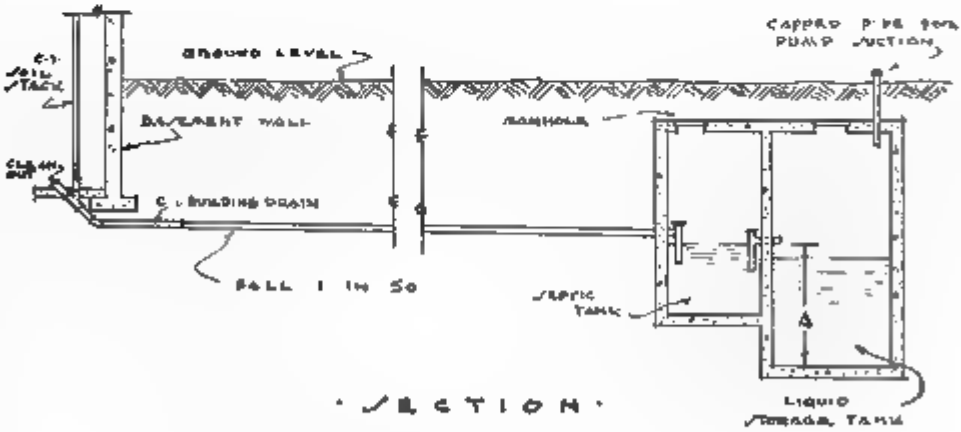


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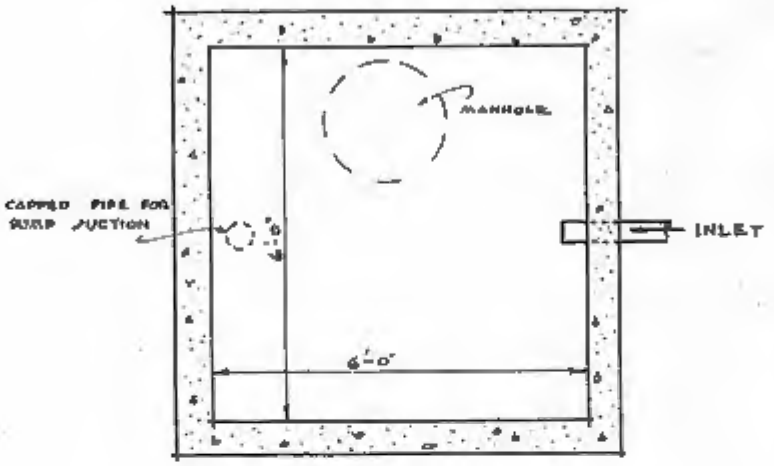
FIGURE 4

DETAIL OF SEEPAGE PIT



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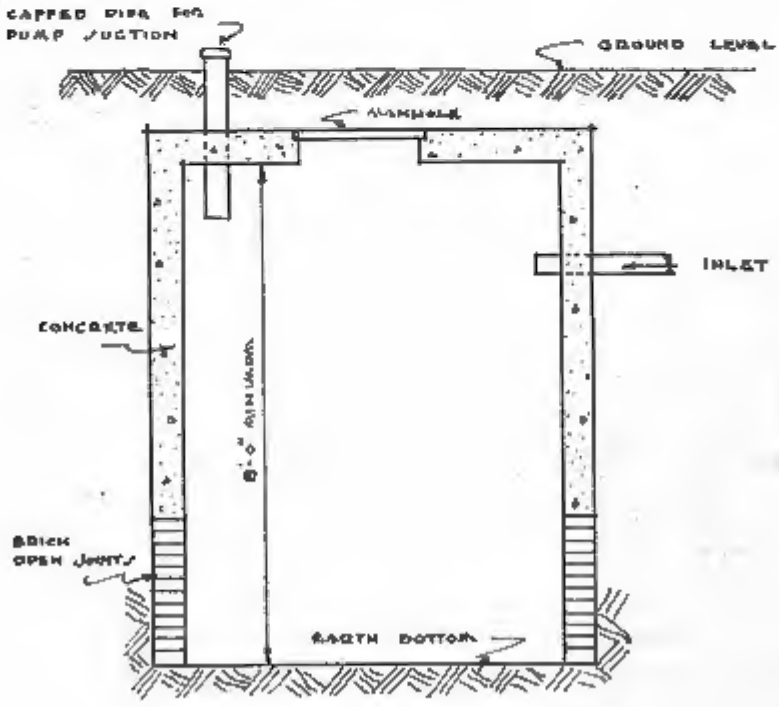

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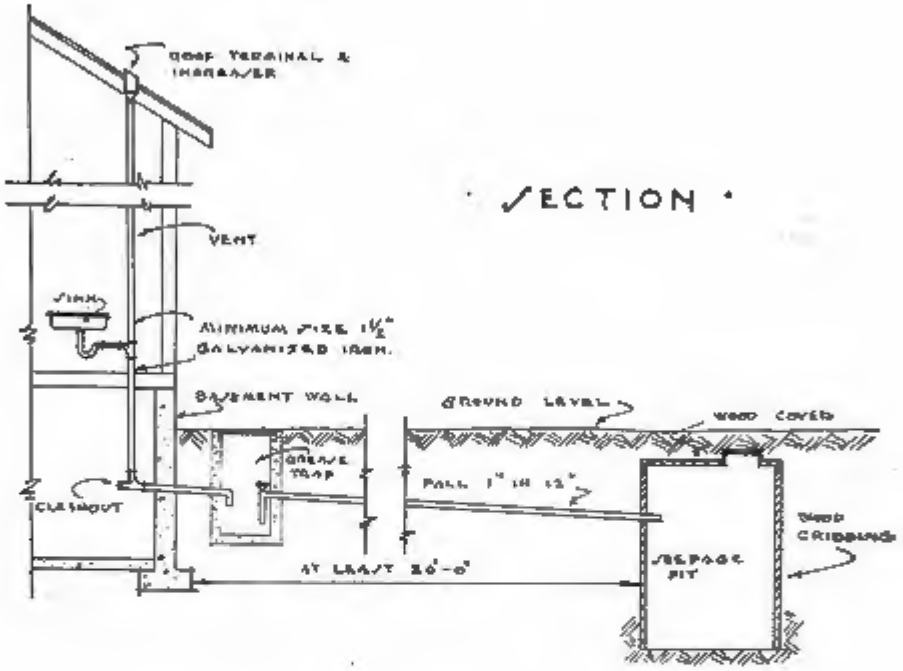
FIGURE 5
DETAIL OF SEEPAGE PIT & GREASE TRAP FOR KITCHEN WASTES



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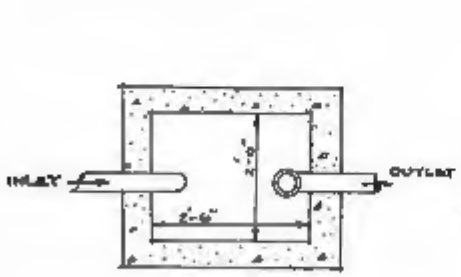

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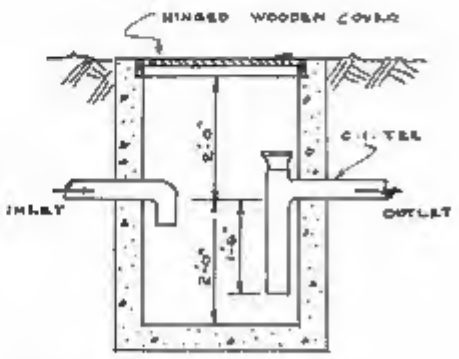

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DETAIL OF GREASE TRAP

ABOVE-GROUND FILTER FOR DWELLING